

TASK ES-8-21

*0244*

TOOL LIST PROGRAM FEASIBILITY STUDY

FINAL REPORT

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**THE NATIONAL SHIPBUILDING  
RESEARCH PROGRAM**

Task ES-8-21  
Tool List Program Feasibility Study  
For Outside Machinery Operations

CONDUCTED AT:

Industrial Engineering Department  
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January 1985 through April 1985

FOR :

Bath Iron Works Corporation  
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The Society of Naval  
Architects and Marine Engineers  
Ship Production Committee  
SP-8 Panel on Industrial Engineering

The U.S. Department of Transportation  
Maritime Administration

# **THE NATIONAL SHIPBUILDING RESEARCH PROGRAM**

## **FINAL REPORT FOR TASK ES-8-21**

**Tool List Program Feasibility Study  
For outside Machinery Operations**

## **PREFACE**

This final report was written to reveal the results of a fourteen (14) week feasibility study on a tool identification list program for outside machinery operations.

The scope of this project includes the complete development and evaluation of a tool identification list pilot program.

This project was performed as part of the National Shipbuilding Research Program, under subcontract to Bath Iron Works Corporation. Funding was provided jointly by the Maritime Administration (MarAd) and the U. S. shipbuilding industry. Administration of this project was through the Society of Naval Architects and Marine Engineers (SNAME) Sp-8 panel on Industrial Engineering. Performance of the project was by the Industrial Engineering Department of Ingalls Shipbuilding.

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## INTRODUCTION

In December of 1983 Ingalls Shipbuilding assumed an active part in the Maritime Administration's National Shipbuilding Research Program. At that time the Industrial Engineering Department at Ingalls began to work on Task ES-8-21, the Data Development of Detail Standards for Outside Machinery Operations. The purpose of this project was twofold. It was primarily to provide the shipbuilding industry with a set of universal standards for Outside Machinery Operations. It was also to identify specific areas where methods improvements could be made to benefit both Ingalls and the U. S. Shipbuilding industry.

It was during the shipyard observations by methods analysts that the problem of excessive travel for tools by outside machinists became apparent. It was observed that some machinists were reporting to shipboard job sites without all of the required tools to perform the job. Numerous trips were made off the ship for additional tools. Further analysis revealed that the problem was costing Ingalls almost one million dollars annually in excessive labor costs. Communications with other shipyards through NSRP (The National Shipbuilding Research Program) Sp-8 Panel on Industrial Engineering revealed that the problem was industry wide.

Seeing that the problem was industry wide, Ingalls submitted a proposal to and received approval from the Sp-8 Panel to implement and evaluate a solution to this problem. The proposed solution was to provide machinists with tool lists that would enumerate all of the necessary equipment required to perform each job. The implementation of this solution was considered capable of reducing the numerous trips made off the ship for additional tools. The implementation of a pilot program utilizing and evaluating the effectiveness of this solution is the subject of this Tool List Program Feasibility Study.



## PROGRAM BENEFITS

### TOOL LIST PROGRAM ADVANTAGES

It is estimated that Ingalls Shipbuilding expends approximately \$900,000 annually in labor costs for excessive tool travel by outside machinists. The tool list program was designed as an instrument to aid in the reduction of excessive travel for tools by outside machinists. The tool list program alone will not totally eliminate excessive travel for tools. Tool lists will however do the following:

- o Provide a comprehensive list of tools required to perform specific tasks.
- o Provide the necessary information to reduce the amount of time an experienced machinist would have to spend planning a job.
- o Provide the necessary information to reduce excessive travel time incurred by inexperienced machinists.

In-yard studies revealed that Ingalls could annually reduce its excessive travel for tools labor costs by \$323,651 annually. This would involve using tool lists in CG 47 class cruisers and LHD assault ship new construction areas aboard ship for outside machinists.

### TOOL LIST PROGRAM DISADVANTAGES

The major disadvantage of the tool list program is that it relies heavily upon the persistence of the outside machinery supervisor. The supervisor must continue to encourage and monitor the use of tool lists or the program will lose its potential.

The tool list program is not a cure-all for the excessive travel for tools problem. Below are some examples of situations for which the tool list concept is rather limited.

- o Tool lists won't eliminate excessive travel for tools costs caused by employees trying to escape from work. Supervisors must monitor their employees work habits to do this. Tool lists can be used in cooperation with good supervision to eliminate excuses for leaving the ship to obtain tools.
- o The tool list concept doesn't work very well with unplanned work. By the very nature of such work it is impossible to anticipate the scope, when it will occur and what tools might be required.

### **TOOL LIST DISADVANTAGES (CONT.)**

- o The tool list concept doesn't work well with complex long term jobs. Tool lists that become multi-page in length tend to be easy to ignore in the long-run.
- o The tool list concept is not conducive to assist type work. Where work descriptions are vague and task requirements are subject to change from ship to ship, it is questionable whether a tool list would significantly reduce excessive travel time.

Even though there are areas where the tool list concept is limited in the shipbuilding environment, the advantages outweigh the disadvantages.

### **TOOL LIST PROGRAM PAYBACK ANALYSIS**

The tool list program does produce savings if properly utilized. However, there are administrative costs associated with the implementation and continued operation of this program. The administrative costs must be considered in a payback analysis to determine the economical feasibility of such a program.

The administrative costs are shown in figure 1. Also shown in figure 1 are the departments involved and the scope of their activities as it relates to the tool list program.

Figure 2 shows the payback analysis. The continuing annual operation cost is subtracted from the gross annual savings to yield a net annual savings. The implementation administrative cost is considered as an investment cost. The payback period is calculated by dividing the investment by the net annual savings.

Based on the information in figure 2 it is economically advantageous for Ingalls to implement the tool list program for the Outside Machinery Department.

# **FIGURE 1 - TOOL LIST PROGRAM**

## **ADMINISTRATIVE COST**

<b>ADMINISTRATIVE IMPLEMENTATION COST</b>	<b>\$ 8 5 , 9 2 0</b>
---	-----------------------

<b>COMPUTER SERVICES (Computer Usage)</b>	<b>1,035</b>
---	--------------

<b>INDUSTRIAL ENGINEERING (Coordination and Tool List Development)</b>	<b>76,125</b>
--	---------------

<b>OUTSIDE MACHINERY (Review Tool List Development)</b>	<b>8,760</b>
---	--------------

<b>ANNUAL ADMINISTRATIVE OPERATING COST</b>	<b>\$ 1 0 , 0 5 9</b>
---	-----------------------

<b>COMPUTER SERVICES (Computer Usage)</b>	<b>1,421</b>
---	--------------

<b>OUTSIDE MACHINERY (Changes and New Equipment)</b>	<b>876</b>
--	------------

<b>PRODUCTION PLANNING (Tool List added to BOM)</b>	<b>7,697</b>
---	--------------

<b>REPROGRAPHIC SERVICES (Additional Paper Generated)</b>	<b>165</b>
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**FIGURE 2****TOOL LIST PROGRAM PAYBACK ANALYSIS**

Gross Annual Savings	\$323,651
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Less Annual Administrative Operating Cost	-10,059
---	---------

Net Annual Savings	313,592
--------------------	---------

INVESTMENT (Administrative Implementation Cost)	\$85,920
---	----------

PAYBACK PERIOD	0.27 YEARS
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### TOOL LIST PROGRAM DESCRIPTION

This Tool List Program was designed to provide the maximum amount of information to the craftsman with the intention of holding the administrative cost of the program to a minimum. The program described in this section was developed by the Ingalls Industrial Engineering Department with the cooperation of the Production Planning Department. The highlight of this program is that the tool list is printed on the bill of material. Use of this system provides a complete summary of both tools and materials required to complete a given job.

### TOOL LIST PROGRAM NETWORK

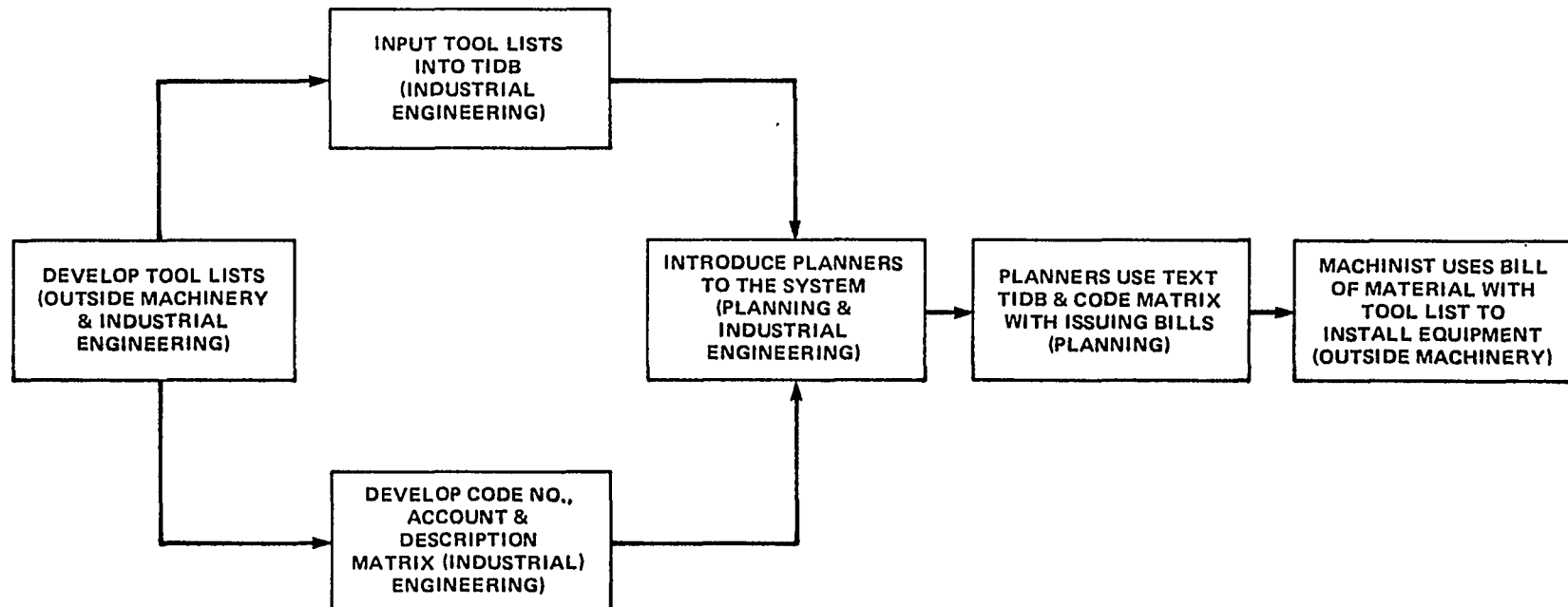
The mechanics of this program directly involved three departments, Industrial Engineering, Production Planning and Outside Machinery (see figure 3). First, Industrial Engineering with the cooperation of Outside Machinery Supervision develops the tool lists (see figure 4). The Industrial Engineering Department then stores the tool lists into the TIDB (Technical Information Data Base) Text System. Industrial Engineering also develops an Account and Item to Tool List Code Number Matrix to identify the location of each tool list in the TIDB System (see figure 5). The Planner then is familiarized with the Matrix and matches each major piece of equipment on a bill of material to a tool list code number. The tool list code numbers, bill of material number and hull number are typed into the TIDB System by the planner. Utilization of this system produces tool lists that are part of the computer generated bill of material (see figure 6). Now the machinists can gather all of the necessary tools and materials to complete a job by referring to one document.

### TIDB TEXT SYSTEM

The TIDB Text (Technical Information Data Base) System is a program written by Ingalls Computer Services Department for the express purpose of adding notes to the bill of material to provide the craft supervisors and workers with information that would assist them in ship construction. During the tool list pilot program, forty-seven (47) tool lists were added to seven hundred seven (707) bill of materials.

Figure 7 shows the five (5) available options of the Text System. Option Number 1 allows tool list data to be input, changed or removed from the computer, thus, the actions create/modify/delete. The tool list data was input into the computer under a dummy bill of material (No. 0000-000-1) and a dummy hull (No. 4500). The second option, Detail Text View, allows one to view the data that has been created, modified or deleted in option number 1. Option Number 3, Merge paragraph from existing bill, allows the tool list stored on the dummy bill of material to be transferred to the large number of bill of materials that the tool list is applicable to. Option No. 4, Bill Paragraph List, displays the paragraph numbers (tool list code numbers) on any given bill of material. Option X allows one to end the session of interaction on the program.

**FIGURE 3 - TOOL LIST PROGRAM NETWORK DIAGRAM**



## **FIGURE 4 - SAMPLE TOOL LIST**

<b>BOAT HANDLING WINCH INSTALLATION MACHINIST TOOLS REQUIRED</b>
<b>1. 6 IN. STEEL SCALE (RIGID)</b>
<b>2. DRILL BITS (17/32 IN. &amp; 25/32 IN.)</b>
<b>3. HAMMER</b>
<b>4. CENTER PUNCH</b>
<b>5. PORTABLE MAGNETIC BASE DRILL</b>
<b>6. SCRIBER</b>
<b>7. FILE (FOR FILING CHOCKS)</b>
<b>8. C-CLAMP</b>
<b>9. RATCHET (1/2 IN. DRIVE)</b>
<b>10. SOCKET (1-1/4 IN.)</b>
<b>11. FIXED END WRENCH (1-1/4 IN.)</b>
<b>12. REAMERS (VARIOUS SIZES 3/4 IN. TO 1 IN.)</b>
<b>13. FEELER GAGE</b>
<b>14. LEVEL</b>

**FIGURE 5 - SAMPLE ACCOUNT AND ITEM TO TOOL LIST CODE NO. MATRIX**

ACCOUNT NO.	ITEM DESCRIPTION	TOOL LIST CODE NO.
2501	BELLMOUTH	0100
2501	COOLING COIL	0101
2501	PRECIPITATOR	0102
2501	FAN COIL ASSEMBLY	0103
2501	FAN COIL UNIT	0104
2501	POWER PACK	0106
2501	TOXIC GAS DAMPER	0107



# FIGURE 6 - PRINTED TOOL LIST ON A BILL OF MATERIAL FORM

DATE: 03/20/85 02:40 BILL REV: 2501-205-1 HULL: 4504 INGALLS SHIPBUILDING MATL CODE: CHANGE REASON: REPORT NO.: X03352-P1  
 DEPT: P P & S REQD-DT: 111984 DISTR: N KITTING REPORT BILL PAGE NO: 1 RPT PAGE NO: 609  
 SCHED ISS: 102204 ACT ISS: 101084 LATEST CHG: 000 LEAD DP: 24 ASSIST DP: 77 WORK STA NO: 530

PLANNER: \_\_\_\_\_  
 DATE: \_\_\_\_/\_\_\_\_/\_\_\_\_  
 COMPLETE: Y M

PARA < < ----- TEXT ----- > >

0104 \*\*\*\*\*  
 OUTSIDE MACHINERY  
 VENTILATION EQUIPMENT  
 TOOL LISTING  
 DESCRIPTION: FAN COIL UNIT  
 SPECIFICATIONS: MODEL H1-H8 & V7  
 WEIGHT 245-805 LBS.  
 FDN BOLT SIZE 5/8 IN.  
 (A) TOOLS REQUIRED FOR INSTALLATION WHEN LINERS AREN'T  
 NECESSARY INCLUDE:  
 BALL PEIN HAMMER DRILL BITS(21/32 IN.)  
 CENTER PUNCH PORTABLE DRILL MOTOR  
 SCRIDER RATCHET(1/2 IN. DRIVE)  
 8' STEEL TAPE EXTENSION(1/2 IN. DRIVE)  
 6" STEEL SCALE SOCKET(15/16 IN.)  
 MOLYCDOTE COMPOUND COMBINATION WRENCH(15/16 IN.)  
 C-CLAMP PRE-MANUFACTURED TEMPLATE  
 CUTTING FLUID  
 (B) TOOLS REQUIRED FOR INSTALLATION WHEN LINERS ARE  
 NECESSARY INCLUDE  
 ALL ITEMS LISTED UNDER (A)  
 FILE  
 FEELER GAGE  
 \*\*\*\*\*

DATE: 03/20/85 02:40 BILL REV: 2501-205-1 HULL: 4504 INGALLS SHIPBUILDING MATL CODE: CHANGE REASON: REPORT NO.: X03352-P1  
 DEPT: P P & S REQD-DT: 111984 DISTR: N KITTING REPORT BILL PAGE NO: 2 RPT PAGE NO: 610  
 SCHED ISS: 102204 ACT ISS: 101084 LATEST CHG: 000 LEAD DP: 24 ASSIST DP: 77 WORK STA NO: 530

LSH	MS DESC	DWG/FH	DLID	COMP	DRV	BRV	DP	QTY	UM	ECO	LOCATION	IPS-QY	OTC-DT	OTC-QY	STATUS	A
F23-805149	B SCREW HEX HEAD CAP 5/8-11 X 1-1/2 LG CS /ELECTRO ZINC PLD CHROMATED	VLD185152	0100	G002	A	000	24	8	EA							101684
F36-266233	B NUT HEX SELF-LOCKING 5/8-11 MS17829-10C STL /ALY HIGH TENSILE CD PLD	VLD105152	0101	G002	A	000	24	8	EA							101684
4120-DA0-642780A1	B FAN COIL UNIT SIZE V-7 W/HTR 9.0 KW	VLD51012	0003	G002	A	000	24	1	EA		A1-02537-01	04000				101684

END OF BILL

## FIGURE 7 - TIDB TEXT SYSTEM OPTIONS

```

*****
* --- TIDB TEXT SYSTEM --- DB81ING      DATE: 04/15/85    TIME: 13:45:18  *
*****
      BILL NUMBER: 0000-000-1      HULL: 4500
      SELECT OPTION: 1      ACTION: C
AVAILABLE OPTIONS:
      1. TEXT CREATE/MODIFY/DELETE
      2. DETAIL TEXT VIEW =====>      TO
      3. MERGE PARAGRAPH FROM EXISTING BILL
      4. BILL PARAGRAPH LIST
      X. EXIT
AVAILABLE ACTIONS:      C. CREATE      M. MODIFY      D. DELETE
      STATUS: 033-*** PLEASE ENTER THE REQUIRED INFORMATION ***

```

## PROJECT ACTIVITIES

The performance of this project was divided into five major activities. These activities were; Develop Plan of Attack, Set-Up Tool List Matrices, Develop Tool Lists, Add Tool Lists to Bill of Material, Evaluate Benefits of Tool List Usage.

### DEVELOP PLAN OF ATTACK

The first activity performed was the development of a detailed plan of attack. This document listed all of the necessary detailed tasks to be completed. The tasks were time phased over the fourteen (14) week span of the project in a manner which would facilitate a steady, even-flow of work throughout the contract. Completion of these tasks were necessary for the successful completion of the entire project.

### SET-UP TOOL LIST MATRICES

The next major step in completing this project was to choose various systems throughout the ship whose equipment would have a high probability of being installed during the time span of the project. This was done so that shipyard observations could be made to evaluate the tool list concept effectiveness. The systems chosen with this purpose in mind were ventilation, main high pressure air system, and the main lubrication oil system. After this step, each major equipment item in each system was identified by account and matched to a four digit tool list code (paragraph no.). The result is a document that can be used by the planner to relate the tool list code to the proper bill of material.

### DEVELOP TOOL LISTS

Industrial Engineering's original proposed involvement in the development of tool lists was to be limited to directing craft supervisors as to which tool lists to develop and to follow-up on their progress. Insteads the Industrial Engineering coordinator reviewed the related drawings and developed the majority of the tool lists. The tool lists were then reviewed with the craft supervisors for approval. A total of forty-seven (47) tool lists were developed during this pilot program, using information from the Ticonderoga (CG 47) Class cruisers under construction at Ingalls Shipbuilding. The tool lists take into consideration the variations in size and manufacturing methods by having a separate section on each tool list to handle each peculiarity.

### DEVELOP TOOL LISTS (CONT.)

The average time required to develop the forty-seven (47) tool lists during this project was 3 hours. This included time to request and review the required **drawings, time to determine the type and size tools required (example: for a ½ in. bolt, determine that the drill size is 17/32 in., socket size is 3/4 in. and the ratchet required would be 1/2 in. drive).** It also includes time to review the developed tool list with the craft and input the tool list into the computer system. Care must be exercised in using this estimated time of 3 hours as time to develop a tool can vary greatly. Depending upon the type of tool list developed the time can range from one-half (1/2) to twelve (12) hours for a single tool list. There are two types of tool lists, a general tool list and a specific tool list. A general tool list for an item incorporates many variations. For example, on a CG 47 Class cruiser there are over one-hundred (100) vaneaxial fans. Therefore, to develop a tool list for a vaneaxial fan over one-hundred drawings have to be requested and reviewed noting the tooling difference of the different sizes. Then, the different sizes have to be classed by similar tooling requirements (see page 28 ). Therefore, a general tool list requires a large amount of time to develop. A specific tool list for an item doesn't have to incorporate any variations because all of the units are identical as far as their tooling requirements are concerned. An example of this is a fan coil unit (see page 23). Even though this item may vary in weight from two hundred sixty-five (265) to eight hundred five (805) pounds the tooling requirements are identical. Therefore, to develop a tool list for a fan coil unit only one fan coil unit drawing is reviewed and the tooling requirements will apply to all variations in size

### ADD TOOL LISTS TO BILL OF MATERIAL

After tool lists were developed, they were input into the TIDB Text "dummy" bill of material created by Industrial Engineering for storage purposes. Then, the Industrial Engineering coordinator reviewed the bill of materials and added the proper tool lists from the dummy bill of material (0000-000-j) to each active bill of material (for example: 2502-302-3). This was done with the TIDB Text System using the merge (No. 3) command (see TIDB Text System section).

### EVALUATE BENEFITS OF TOOL LIST USAGE

The final phase of this pilot program was an evaluation of the effectiveness of the tool list concept. In-yard studies were performed with machinists who had tool lists. Supervisors made the machinists aware of the proper use of the tool lists and Industrial Engineering observed the machinists activities. Cost savings data was generated from these observations.

Another part of the evaluate benefits phase, was the development of the administrative cost and determining if the program was economically feasible.

The purpose of this section of the report is to expound upon the benefits Ingalls Shipbuilding received from this pilot program. It also reveals the requirements for Ingalls to fully implement this program and to fully realize all of the potential savings.

Below are the original pilot program tasks.

1. Industrial Engineering and Outside Machinery Departments were to work together to develop as many of the five hundred (500) CG 47 class cruiser related tool lists as possible during the time frame available.
2. Industrial Engineering was to input the tool lists into the TIDB Text System.
3. Industrial Engineering was to develop tool list code number, account and description matrices.
4. Production Planning was to use the code number, account and description matrices to match each major piece of equipment on a bill of material to the appropriate tool list code number.
5. Industrial Engineering was to publish a final report revealing the effectiveness, administrative cost and economic feasibility of a tool list program.

Status of tasks at end of pilot program.

1. A total of forty-seven (47) tool lists were developed.
2. Industrial Engineering input forty-seven (47) tool lists into the TIDB Text System.
3. Industrial Engineering coordinator developed code number, account and description matrices for forty-seven (47) tool lists.
4. Industrial Engineering added the tool lists to seven hundred seven (707) bill of materials on CG 53 through CG 57, CG 59, and CG 62.
5. Industrial Engineering conducted in-yard studies and determined that tool lists were being used by outside machinists. In every case studied, where tool lists were provided, excessive job preparation was eliminated.

### TOOL LIST PILOT PROGRAM EVALUATION (CONT.)

The total excessive job preparation problem at Ingalls represents \$898,527 annually in labor costs. The effect of tool lists on the total excessive job preparation problem was determined by the following actions:

- o Re-evaluating the initial studies and identifying those instances where only direct supervision control could have eliminated *excessive* job preparation.
- o Identifying those jobs which the tool list concept would be ineffective (example: unplanned work).
- o Performing in-yard studies to determine how often the tool list is used by the machinist.

The re-evaluation of the initial studies revealed that \$252,517 annually could be controlled directly by supervisors. The identification of those jobs where the tool list concept is ineffective represented \$322,359 annually. Performance of in-yard studies revealed that in every *case* where tool lists were provided, excessive job preparation was eliminated. Taking these factors into account, the effect of a fully implemented tool list program at Ingalls would annually save \$323,651. The forty-seven (47) tool lists developed during this pilot program represents fourteen and seven-tenths percent (14.7%) of the work effort where tool lists can be used. When this percentage is applied to the annual savings of a fully implemented program it yields a savings of \$47,577 annually. This savings was incurred as a direct result of this pilot program (see figure 8). To obtain additional savings from this tool list program, additional tool lists would have to be developed and added to bill of materials. The time frame required to complete the implementation phase of such a project would be one year.

## FIGURE 8- TOOL LIST PROGRAM ANNUAL COST SAVINGS

<b>ANNUAL. EXCESSIVE JOB PREPARATION COST</b>	<b>\$ 898,527</b>
---	-------------------

<b>LESS SUPERVISION RELATED COST</b>	<b>-252,517</b>
--------------------------------------	-----------------

- REPORTING TO JOB SITE WITHOUT ANY TOOLS
- . RETURNING TOOLS UNNECESSARILY BEFORE SHIFT ENDS

<b>LESS UNCONTROLLABLE COST</b>	<b>-322,359</b>
---------------------------------	-----------------

- . UNPLANNED WORK
- . ASSIST WORK
- . COMPLEX, LONG DURATION TASKS

<b>TOTAL SAVINGS OF A FULLY IMPLEMENTED TOOL LIST PROGRAM AT INGALLS</b>	<b>323,651</b>
--	----------------

<b>TOTAL SAVINGS INCURRED- AS A DIRECT RESULT OF THIS PILOT PROGRAM"</b>	<b>47,577</b>
--	---------------

TOOL LIST SUMMARY

<u>VENTILATION SYSTEM EQUIPMENT</u>	<u>TOOL LIST CODE</u>	<u>PAGE</u>
BELLMOUTH FAN INTAKE	0100	19
COOLING COIL	0101	20
ELECTROSTATIC PRECIPITATOR	0102	21
FAN COIL ASSEMBLY	0103	22
FAN COIL UNIT	0104	23
GRAVITY COIL	0105	24
POWER PACK	0106	25
TOXIC GAS DAMPER	0107	26
TUBEAXIAL FAN	0108	27
VANEAXIAL FAN	0109	28
VENTILATION HEATER	0110	29
 <u>MAIN HIGH PRESSURE AIR SYSTEM EQUIPMENT</u>		
AIR FLASK - 0.5 CU. FT.	0120	30
AIR FLASK - 1.5 CU- FT.	0121	31
AIR FLASK - 6.0 CU. FT.	0122	32
AIR FLASK - 8.0 CU. FT.	0123	33
BLIND FLANGE - 8 IN. IpS	0124	35
HOSE REEL	0125	36
RELAY TANK	0126	37
AIR DRYER	0127	38
 <u>MAIN OIL LUBRICATION SYSTEM EQUIPMENT</u>		
ELECTRIC-WATER HEATER	0130	39
LUBE OIL COOLER	0131	40
LUBE OIL FILTER	0132	41
LUBE OIL PURIFIER	0133	42
LUBE OIL PURIFIER HEATER	0134	43
LUBE OIL PURIFIER STRAINER	0135	44
LUBE OIL SERVICE PUMP	0136	45
LUBE OIL STORAGE AND COND. ASSEMBLY	0137	46



TOOL LIST SUMMARY (CONT.)

<u>MISCELLANEOUS EQUIPMENT</u>	<u>TOOL LIST CODE</u>	<u>PAGE</u>
AIR CONDITIONING PLANT	9200	47
ELECTRICAL ENCLOSURE	9201	48
SHIP'S SERVICE EMERGENCY GENERATOR	9202	49
FIVE INCH GUN MOUNT MACHINING	9203	50
STERN TUBE AND STRUT BORING	9204	51
MAIN ENGINE PAD MACHINING	9205	52
WASTE HEAT BOILER	9206	53
CHILL WATER PUMP	9207	54
BOAT HANDLING WINCH	9208	55
SEWAGE PUMP	9209	56
BRIDGE CRANE AND RAILS	9210	57
CONVECTION OVEN	9211	58
HOIST AND MONORAIL	9212	59
BORING RUDDER CASTINGS	9213	60
CAPSTAN	9214	61
OPERATING GEAR INSTALLATION	9215	62
HYDRAULIC OIL POWER MODULE	9216	63
FEED PUMP	9217	64
AEGIS WATER COOLER	9218	65
ISOLATOR FOR 400 HERTZ CONVERTER	9219	66

INGALLS SHIPBUILDING DIVISION

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*
*          OUTSIDE MACHINERY
*      VENTILATION EQUIPMENT
*          TOOL LISTING
*
* DESCRIPTION:     FAN COIL ASSEMBLY
*
* SPECIFICATIONS: SIZE           21-25 TONS
*                  WEIGHT        1381-1823 LBS.
*                  FON BOLT SIZE    1 IN.
*
* (A) TOOLS REQUIRED FOR INSTALLATION WHEN LINERS AREN'T NECESSARY INCLUDE:
*
* BALL PEIN HAMMER   DRILL BITS(1-1/16,25/32,17/64 IN.)
* CENTER PUNCH       PORTABLE DRILL MOTOR
* SCRIBER            RATCHET(1/2 IN. DRIVE)
* 8' STEEL TAPE      EXTENSION(1/2 IN. DRIVE)
* 6'' STEEL SCALE    SOCKET(1/2 IN.)
* MOLYCOTE COMPOUND  COMBINATION WRENCH(1/2 IN.)
* CUTTING FLUID      PRE-MANUFACTURED TEMPLATE
*
* (B) TOOLS REQUIRED FOR INSTALLATION WHEN LINERS ARE NECESSARY INCLUDE:
*
* ALL ITEMS LISTED UNDER(A)
* FILE
* FEELER GAGE
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*                                     *
*          OUTSIDE MACHINERY          *
*        VENTILATION EQUIPMENT        *
*          TOOL LISTING                *
*                                     *
* DESCRIPTION:          VANEAXIAL FAN  *
*                                     *
* SPECIFICATIONS:       *
*                                     *
*   SIZE                A1/4A - A2A    A2-1/2A - A7A    A8A - A16A *
*   WEIGHT(LBS)         65 - 180       220 - 530       600 - 1100 *
*   FDN BOLT SIZE       5/16,3/8,      1/2,5/8         1/2,5/8 *
*   (IN)                9/16,1/2,5/8   3/4             *
*   LIST ID             (A)              (B)              (C) *
*                                     *
* (A) TOOLS REQUIRED FOR INSTALLATION OF A SIZE A1/4A THRU *
*   A2A FAN INCLUDE: *
*                                     *
*   PAINT BRUSH          FEELER GAGE *
*   FILE                 RATCHET(1/2 IN. DRIVE) *
*   MOLYCOTE COMPOUND    EXTENSION(1/2 IN DRIVE) *
*   COMB. WRENCH         SOCKET(1/2,9/16,3/4,13/16,15/16 IN)*
*   (1/2,9/16,3/4,      RESILIENT MOUNT PRESERVATIVE(SPRAY-*
*   13/16,15/16 IN.)    LAC) *
*   HAMMER              STENCIL(1/4 OR 1/8 IN.) *
*                                     *
* (B) TOOLS REQUIRED FOR INSTALLATION OF SIZE A2-1/2A THRU *
*   A7A FANS INCLUDES: *
*                                     *
*   ALL ITEMS LISTED UNDER (A). SOCKETS AND COMBINATION *
*   WRENCH SIZES ARE DIFFERENT. *
*   SOCKETS(3/4, 15/16 IN.) *
*   COMBINATION WRENCH(3/4, 15/16 IN.) *
*                                     *
* (C) TOOLS REQUIRED FOR INSTALLATION OF SIZE A8A THRU A16A*
*   FANS INCLUDES: *
*                                     *
*   ALL ITEMS LISTED UNDER (A). SOCKET AND COMBINATION *
*   WRENCH SIZES ARE DIFFERENT. *
*   SOCKETS(3/4,15/16,1-1/8 IN.) *
*   COMBINATION WRENCH(3/4,15/16,1-1/16, 1-1/8 IN.) *
*                                     *
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 SCHED ISS:      ACT ISS:      LATEST CHG:      LEAD DP:      ASSIST DP:      WORK STA NO: 22

0122

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*                               *
*      OUTSIDE MACHINERY      *
*      MAIN HIGH PRESSURE AIR SYSTEM EQUIPMENT *
*      TOOL LISTING          *
*                               *
* DESCRIPTION:      AIR FLASK - 6.0 CU. FT. *
*                               *
* SPECIFICATIONS:   DRAWING NO.  APPLICABILITY(VLD SERIES) *
*                               *
* CAPACITY(CU. FT.) 6.0          6.0          6.0          *
* WEIGHT(LBS.)      680          720          615          *
* FDN BOLT SIZE(IN.) 1-1/8        3/4          5/8          *
* LIST ID           (A)          (B)          (C)          *
*                               *
* (A) TOOLS REQUIRED FOR INSTALLATION OF A 6.0 CU. FT. AIR *
* FLASK ON DRAWING VLD185366 INCLUDES: *
*                               *
* BALL PEIN HAMMER   DRILL BITS(17/64,25/32,1-3/16 IN.)*
* CENTER PUNCH       PORTABLE DRILL MOTOR *
* SCRIBER            RATCHET(1/2 IN. DRIVE) *
* 8' STEEL TAPE      EXTENSION(1/2 IN. DRIVE) *
* 6" STEEL SCALE     SOCKET(1-11/16 IN.) *
* FILE              COMBINATION WRENCH(1-11/16 IN.) *
* FEELER GAGE        C-CLAMP *
* MARKER            MOLYCOTE OR CSA COMPOUND *
* CUTTING FLUID *
*                               *
* (B) TOOLS REQUIRED FOR INSTALLATION OF A 6.0 CU. FT. AIR *
* FLASK ON DRAWING VLD185117 INCLUDES: *
*                               *
* ALL ITEMS LISTED IN (A). SOCKET,DRIL BIT, AND COMB- *
* INATION WRENCH SIZES DIFFER. *
* SOCKET(1-1/8 IN.) *
* DRILL BITS(17/64, & 25/32 IN.) *
* COMBINATION WRENCH(1-1/8 & 1-1/16 IN.) *
*                               *
* (C) TOOLS REQUIRED FOR INSTALLATION OF A 6.0 CU. FT. AIR *
* FLASK ON DRAWING VLD185649 INCLUDES: *
*                               *
* ALL ITEMS LISTED IN (A). SOCKET, DRILL BIT, AND COMB- *
* INATION WRENCH SIZES DIFFER. *
* SOCKET(15/16 IN.) *
* COMBINATION WRENCH(15/16 IN.) *
* DRILL BITS(17/64 & 21/32 IN.) *
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DATE: 04/11/85      BILL: 0000-000-0      HULL: 4500      DESC: NO DESCRIPTION FOUND ON CDB  
 DEPT: ENGINEERING      DISTR: M      KITTING REPORT TEXT FLY-SHEET      BILL PAGE NO: 15  
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*                               *
*      OUTSIDE MACHINERY      *
*      MAIN HIGH PRESSURE AIR SYSTEM EQUIPMENT *
*      TOOL LISTING          *
*                               *
* DESCRIPTION:      AIR FLASK - 8.0 CU. FT. *
*                               *
* SPECIFICATIONS:  DRAWING NO. APPLICABILITY(VLD SERIES) *
*      185368      185118      185366      185016 *
*                               *
*      185363 *
* CAPACITY(CU. FT.)      8.0      8.0      8.0      8.0 *
* WEIGHT(LBS.)          800      720-800      800      800 *
* FDN BOLT SIZE(IN.)    5/8      3/4      1-1/8      1 *
* LIST ID              (A)      (B)      (C)      (D) *
*                               *
* (A) TOOLS REQUIRED FOR INSTALLATION OF A 8.0 CU. FT. AIR *
*      FLASK DRAWING VLD185368 INCLUDES: *
*                               *
*      BALL PEIN HAMMER      DRILL BITS(21/32 & 15/16 IN.) *
*      CENTER PUNCH          PORTABLE DRILL MOTOR *
*      SCRIBER                RATCHET(1/2 & 1 IN. DRIVE) *
*      8' STEEL TAPE          EXTENSION(1/2 & 1 IN. DRIVE) *
*      6" STEEL SCALE        SOCKET(15/16 & 1-5/16 IN.) *
*      FILE                  COMB. WRENCHES(15/16 & 1-5/16 IN.)*
*      FEELER GAGE          C-CLAMP *
*      MARKER                MOLYCOTE OR CSA COMPOUND *
*      UTILITY KNIFE         PAINT BRUSH *
*      200' AIR LINE         AIR IMPACT WRENCH *
*      CUTTING FLUID *
*                               *
* (B) TOOLS REQUIRED FOR INSTALLATION OF A 8.0 CU. FT. AIR *
*      FLASK DRAWING VLD185118 & VLD185363 INCLUDES: *
*                               *
*      ALL ITEMS LISTED IN (A) EXCEPT PAINT BRUSH AND UTIL- *
*      ITY KNIFE. SOCKET, COMB. WRENCH, & DRILL BIT SIZES *
*      DIFFER. *
*      SOCKET(1-1/8 IN.) *
*      COMBINATION WRENCH(1-1/8 & 1-1/16 IN.) *
*                               *
* (C) TOOLS REQUIRED FOR INSTALLATION OF A 8.0 CU. FT. AIR *
*      FLASK ON DRAWING VLD185366 INCLUDES: *
*                               *
*      ALL ITEMS INCLUDED IN (A) EXCEPT PAINT BRUSH AND *
*      UTILITY KNIFE. SOCKET, COMBINATION WRENCH, DRILL BIT *
*      SIZES DIFFER. *
*      SOCKET(1-11/16 IN.) *
*      DRILL BITS(17/64, 21/32, 25/32, 1-3/16 IN.) *
*      COMBINATION WRENCH(1-11/16 IN.) *
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*
* (D) TOOLS REQUIRED FOR INSTALLATION OF 8.0 CU. FT. AIR
*   FLASK ON DRAWING VLD185016 INCLUDES:
*
*   ALL ITEMS INCLUDED IN (A) EXCEPT PAINT BRUSH & UTIL-
*   ITY KNIFE. SOCKET, COMBINATION WRENCH, & DRILL BIT
*   SIZES DIFFER.
*   SOCKET(1-1/2 IN.)
*   COMBINATION WRENCH(1-1/2 IN.)
*   DRILL BIT(1-1/16, 21/32, 17/64 IN.)
*

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BILL: 0000-000-0 HULL: 4500  
DISTR: M K  
ACT ISS: LATEST CHG:

## INGALLS SHIPBUILDING DIVISION

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      OUTSIDE MACHINERY
MAIN HIGH PRESSURE AIR SYSTEM EQUIPMENT
      TOOL LISTING

DESCRIPTION:      8 IN. IPS BLIND FLANGE

SPECIFICATIONS:   BOLT SIZE    3/4 IN.


(A) TOOLS REQUIRED FOR INSTALLATION INCLUDES:

GASKET PUNCH          COMBINATION WRENCH(1-1/16 IN.)
UTILITY KNIFE          SOCKET(I-1/8 IN.)
MOLYCOTE COMPOUND     RATCHET(I/2 IN. DRIVE)
                      EXTENSION(I/2 IN. DRIVE)

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ACT ISS: LAT

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0130

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*                                     *
*      OUTSIDE MACHINERY              *
*      MAIN OIL LUBRICATION SYSTEM EQUIPMENT      *
*      TOOL LISTING                    *

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\* DESCRIPTION: ELECTRIC WATER HEATER \*

\* SPECIFICATIONS: CAPACITY 5 GALLON

* * *	WEIGHT	130 LBS.	* *
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* FDN BOLT SIZE	5/8 IN.	*
-----------------	---------	---

\* A) TOOLS REQUIRED FOR INSTALLATION INCLUDE:

\* BALL PEIN HAMMER      DRILL BITS(21/32 IN.)

* CENTER PUNCH	DRILL BITS(21/32 IN.)	*
	PORTABLE DRILL MOTOR	*

\* SCRIBER RATCHET(1/2 IN. DRIVE)

\* 8' STEEL TAPE EXTENSION(1/2 IN. DRIVE)

\* 6" STEEL SCALE SOCKET(15/16 IN.) \*

\* BUCKEYE GRINDER COMBINATION WRENCH(15/16 IN.) \*

\* 200' AIR LINE MOLYCOTE OR C5A COMPOUND \*

* AIR WHIP	CUTTING FLUID	*
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DEPT: ENGINEERING DISTR: H KITTING REPORT TEXT FLY-SHEET BILL PAGE NO: 32  
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9203

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BILL: 0000-000-0 HULL: 4500 DESC: NO DESCRIPTION FOUND ON CDB  
DISTR: M KITTING REPORT TEXT FLY-SHEET  
ACT ISS: LATEST CHG: LEAD DP:

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INGALLS SHIPBUILDING DIVISION  
BILL: 0000-000-0 HULL: 4500 DESC: NO DESCRIPTION FOUND ON CDB  
DISTR: M KITTING REPORT TEXT FLY-SHEET  
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INGALLS SHIPBUILDING DIVISION  
00 DESC: NO DESCRIPTION FOUND ON CDB  
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*%*****S*****X*N*****X*****%*****  
*                                     *  
*      OUTSIDE MACHINERY            *  
*    MAIN AND AUXILARY FEED CONDENSATE SYSTEM EQUIPMENT   *  
*          TOOL LISTING              *  
*                                     *  
* DESCRIPTION:                      FEED PUMP               *  
*                                     *  
* SPECIFICATIONS:                  FOR CG-47 CLASS CRUISER  *  
*                                     *  
*                                     *  
* (A) TOOLS REQUIRED FOR INSTALLATION INCLUDE:  
*                                     *  
* BALL PEIN HAMMER                 DRILL BITS(1/4 & 21/32 IN.) *  
* CENTER PUNCH                     PORTABLE DRILL MOTOR     *  
* SCRIBER                          RATCHET(1/2 & 1 IN. DRIVE) *  
* 8' STEEL TAPE                    EXTENSIONAL(1/2 IN. DRIVE) *  
* 6" STEEL SCALE                   SOCKET(1-1/16, 1-1/8 & 1-5/16 IN.) *  
* BUCKEYE GRINDER                 COMBINATION WRENCH(1-1/16,1-1/8 &  
* AIR WHIP                        1-5/16 IN.)                *  
* 200' AIR LINE                   MOLYCOTE OR C5A COMPOUND       *  
* CUTTING FLUID  
  
*  
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